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PATENT SPECIFICATION

Convention Date (Switzerland): Dec. 31, 1932.

413,960

Application Date (in United Kingdom): Dec. 16, 1933. No. 35,497/33.

Complete Accepted: July 26, 1934.

COMPLETE SPECIFICATION.

Improvements in or relating to Two-stroke Cycle Internal Combustion Engines Operating with Pre-compressed Charge.

I, ALFRED BÜCHI, of Salstr. 20, Winterthur, Switzerland, a citizen of the Swiss Republic, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to two stroke cycle internal combustion engines operating with pre-compressed charge, exhaust gas from the engine cylinders being employed for pre-compressing the charge.

In connection with internal combustion engines of this type, it is known to lead the portion of the exhaust gases which is to be recuperated for pre-compressing the charge to a thermo-motor in the form of a turbine which is operatively associated with a rotary blower or the like for supplying the pre-compressed charge to the internal combustion engine.

An arrangement of a known power plant operating on this principle provides for an axial cylinder extension equipped with different sets of ports for separating the exhaust gases from a two-stroke cycle internal combustion engine during each exhausting period into different pressure stages of which the highest is utilised in the turbine, means being associated with said cylinder extension for controlling said ports.

Another known arrangement of a plant operating on this principle provides valve mechanism for tapping off the exhaust gases of an internal combustion engine of the two or four-stroke type in two or more distinct stages during the period in which the said gases are being exhausted under their own pressure, by which term those gases are meant which are expelled before the piston returns upon its exhaust stroke in a four-cycle engine and the gases expelled before admission of scavenging or charging air in a two-stroke engine. The thus obtained different stages of the exhaust gases of different pressures may be employed to drive separate turbines or separately fed sections of a single turbine, and certain portions of the gases may be discharged directly into the atmosphere or into a chamber if desired together with the residual exhaust gases of the engine.

Still another known arrangement of an aggregate operating on this principle provides for inlet and exhaust ports situated in the wall of the cylinder of an internal combustion engine of the two-stroke type where they will be uncovered by the piston towards the end of its outstroke and for an auxiliary exhaust port in the wall of the cylinder adjacent to the main exhaust port but where this port will be uncovered by the piston before this main exhaust port is uncovered to deliver the exhaust gas portion to be used for thermomotive purposes to a turbine of suitable construction through a pipe communicating with said auxiliary exhaust port.

It is also known to artificially increase the temperature in front of the exhaust turbine associated with an internal combustion engine, when the turbine is running idle or at light loads, at least above condensation temperature of the water in the exhaust gases entering the turbine, for the purpose, for instance, of preventing the formation of acids and the like, which would attack the various parts of the turbine.

The object of the present invention is to avoid the use of exhaust turbines in association with the internal combustion engine for pre-compressing the charge, in order to avoid the drawback inherent to turbines in general which consists in the poor degree of efficiency of these machines when running at light loads. This is accomplished according to the invention by providing a supercharger in the form of a rotary pump comprising both a motor part and a pumping part for expanding the exhaust gas and for compressing the charging air respectively, whereby in a known manner a portion of the exhaust gases is passed from the combustion cylinders into the atmosphere and only another portion of the exhaust gases of a higher pressure and leaving the cylinder wall through separate apertures is utilized for generating energy in the motor part of said pump, for pre-compressing the charge.

By the use of a charging pump of this type considerable economy of space is ob-

[Price 1/-]

Price 4s 6d

tained which is essential for the supercharging means of internal combustion engines. Furthermore, a better recuperating effect of the residual thermal energy of the exhaust gases is afforded, as this type of pumps operates on the entire speed range entering into question at a high degree of efficiency. Moreover, due to the working pockets of this pump being alternately used for expanding the hot exhaust gases and compressing the cold charging air, these pockets are periodically cooled, while the provision of supplementary means for artificially increasing the temperature in front of the pump when running at light loads is unnecessary owing to the fore favorable construction of the rotary pump in this respect.

In the accompanying drawings several constructional forms of the invention are schematically illustrated by way of example only.

In all the Figures of the drawing like numerals designate like parts.

Figs. 1 and 2 show in a sectional elevation and in plan a single acting two-stroke cycle internal combustion engine, embodying the invention.

Figs. 3 and 4 are similar views of an engine of this kind but with a modified construction of the main charging pump and of the combustion cylinders.

Figs. 5 and 6 depict in a sectional elevation a vertical arrangement of a charging blower aggregrate according to the invention, and the

Figs. 7 and 8 illustrate in two similar views a double acting two-stroke cycle engine embodying the invention.

The engines embodying the invention are designated by 1, whereas 2 refers to the working pistons and 3 to the connecting rods thereof by means of which the piston movements are transmitted to the crank shaft 4. The reference numeral 5 represents the working or combustion cylinders which are shown to be six in number in Fig. 2. The sectional elevation shown in Fig. 1 includes a section through one of the combustion cylinders, the water jacket of the cylinder being omitted for the sake of clearness. The main charging pump 6 is in the form of a rotary blower comprising slide blades 7 that are urged outwardly by action of centrifugal force and impelled by a drum 8. The drum 8 is eccentrically mounted relatively to the casing in bearings 9. For sealing the drum carrier shaft in the longitudinal direction, stuffing boxes 10 are provided.

The casing 11 of the main charging pump as well as the rotor 8 are adapted to be cooled by a cooling medium. This medium enters the drum 8 via conduit 12 and leaves the same again via conduit 13. The cooling medium for cooling the casing 11 is admitted thereto through conduit 14 to leave the same again through conduit 15. The main charging pump is so designed that the rotor 8 is horizontally offset to the left relatively to the casing 11. The crescent-shaped spaced formed between the casing 11 and the drum 8 by the eccentric disposition of these parts is situated remote from the motor.

The drum 8 rotates anticlockwise, so that the upper half of the charging pump 6 acts to compress the fresh charge for the motor and the lower half to expand the exhaust gases. In following the piston movement of the internal combustion engine during the expansion incidence, it will be seen that during the downward movement of the piston the upper edge of the same uncovers the control aperture 16 first. Due to this aperture being opened, the exhaust gases pass over to the expansion space 18 of the charging pump through conduit 17 to expand thereat. The exhaust gases then pass over in expanded condition to an exhaust conduit 21 through apertures 20 in the casing 11.

At this moment or shortly afterwards, lateral apertures 22 of the casing 11 are uncovered for admitting scavenging air supplied by a ventilator 23. This air scavenges the crescent-shaped spaces most remote from the internal combustion engine, thus clearing them from exhaust gas residues. On the backside of the charging pump, further apertures 24 may be provided and the arrangement may be such that the exhaust gases are withdrawn from the crescent-shaped space by a suction ventilator 25 and forced into the exhaust conduit 21 also through an additional conduit 26. In this manner it is possible to clear the crescent-shaped space from exhaust gas after expansion of the same and to refill these spaces with fresh charge, whereafter, on the further rotation of the rotor 8, this fresh charge is also compressed in the upper half of the charging compressor 6. In order to permit pre-compressing to different gas pressures at a high degree of efficiency, automatic pressure relief valves 27 may be provided, on the compression side of the rotary main charging pump. Thus, if for example at a certain moment during the operation the pressure in the charging air in front of said valves is higher than that reigning in the working pocket of said pump then passing by the backside of the first of these back-pressure flaps 27, said flap remains closed. As, on the rotor of the main charging pump continuing its movement, the volumetric capacity of this

working pocket decreases, the pressure inside the latter increases thus adapting the charging air to open the next succeeding one or one of a series of following back-pressure flaps for educting charging air by the own effort of this air. The arrangement of the relief valves thus permits of regulating the pressure in the charging air, while at the same time that portion of this air having been expelled from the working pockets is prevented from flowing back into the pockets, in order to prevent loss of energy from this source.

According to the invention, the piston uncovers further apertures 28 in the wall of the cylinder at the end of the expansion period to discharge the low pressure portion of the combustion gases into the exhaust conduit 29 and from there into the exhaust conduit 21.

Consequently, this portion of the gases is not utilised for generating energy in the charging pump. Shortly after the apertures 28 have been uncovered by the piston, inlet ports 30 are uncovered, by the descending piston. Through these ports 30 the pre-compressed fresh charge enters which arrives at these ports 30 from the charging pump through conduit 31. In all the conduits 17, 29 or 31 shut-off or non-return valves or the like as shown at 32, 33 and 34 in Fig. 1 may be included for preventing backing up of exhaust gas or fresh charge at an improper time in the direction towards the combustion cylinders or the charging pump, or the exhaust conduit respectively.

In the embodiment as per the Figs. 3 and 4, the rotor 8 is vertically offset relatively to the casing 11 of the charge pre-compressor towards above. Otherwise the construction of the charge pre-compressor and that of the conduction means connecting this compressor with the combustion cylinders are in principle the same. Similarly as in the embodiment shown in Fig. 1, a two-stroke cycle engine is chosen which comprises two rows of port slots, an upper row 35 and a lower row 30, for admission of charging air. The admission from conduit 31 to the upper slots 35 is controlled by a shut-off member, for example in the form of a back pressure valve 36 as shown.

These valves prevent exhaust gas of higher pressure from passing over to the charge admission conduit 31 during the downward movement of the piston, as long as the pressure in the cylinder is still higher than that of the charging pressure in the conduit 31. The admission slots 30 and 35 are, however, differently arranged relatively to the exhaust slots 28, i.e. the border between the admission and exhaust regions extends transversely to the axis of the machine. By this means it is possible to arrange the entrance pipe studs 37 for the charge and the exhaust pipe studs 38 for the exhaust gases on the same side, that is, the side on which the charging blower is situated. In this manner the admission and exhaust pipe arrangements between the combustion cylinders and the charging blower are simplified.

In the Figs. 3 and 4, it will be further seen that the charging blower may be imparted an additional driving impulse by the rotating parts of the engine, for example by means of a chain drive 39.

The Figs. 5 and 6 show an embodiment wherein the charging blower 6 is arranged vertically between two working cylinders. Otherwise the construction is similar to that disclosed in the Figs. 1 and 2. The drive of the auxiliary scavenging blower 23, on the other hand is effected by means of a speed acceleration gear 40, 41 for increasing the speed of this blower. The correlation of a charging blower to but a few cylinders, for example two, is advantageous, when these cylinders generate a relatively great amount of power, with a view to simplifying the pipe arrangement.

In the Figs. 7 and 8, a double acting two-stroke cycle engine is shown, wherein a horizontally disposed charging blower is associated with four working cylinders. The design is similar to that used for single acting engines, except that of the two exhaust ports 16 one is correlated to the upper side of the piston and the other to the lower side thereof, for conducting the exhaust gases through conduit 17 to the charging blower. In this constructional example of the invention, in addition to the shut-off valve 32, two back-pressure flaps 42 are inserted in this conduit, for preventing the exhaust gas present in the conduit 17 flowing into the cylinder spaces at an improper time. The charging air is admitted to the cylinders through the conduit 31 leading to the entrance slots 30 and 35 in a manner known per se for two stroke cycle engines. The discharge of the low pressure exhaust gas into the exhaust gas conduit 21 is effected through apertures 28. Otherwise the construction is equal to that shown in the Figs. 1 to 6.

In every one of the embodiments shown, the blower means employed may be imparted an additional driving impulse from the rotating parts of the internal combustion engine or from any other source of power, such as an electromotor or the like.

In none of the embodiments a fuel in-

jection device is shown in the drawings to be arranged in the combustion cylinders, as this is considered to be a matter of course. Any suitable device of this kind can be used in connection with the invention.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A two-stroke cycle internal combustion engine operating with pre-compressed charge, characterized by the fact that the expansion means for utilizing the exhaust gases and the compression means for compressing the charging air are both arranged in one and the same charging pump in the form of a rotary pump, whereby in a known manner a portion of the exhaust gases is passed from the combustion cylinders into the atmosphere and only another portion of the exhaust gases of a higher pressure and leaving the cylinder wall through separate apertures is utilized for generating energy in the expansion part of said pump, for pre-compressing the charge.

2. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that in the exhaust conduit from the combustion cylinder to the expansion part of the charging pump a control member is included which is opened during the period of admission of the exhaust gases into the expansion part of the charging pump and thereupon is closed again.

3. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that in the exhaust conduit between the combustion cylinder and the expansion part of the charging pump in the vicinity of the combustion cylinder automatically closing shut-off members are included which are adapted to prevent exhaust gas flowing back into the combustion cylinder during the scavenging and charging periods as well as the compression stroke.

4. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that the exhaust gases leaving the charging pump and the exhaust gases immediately passing out of the combustion cylinders are educted through a common exhaust conduit.

5. A two-stroke cycle internal combustion engone operating with pre-compressed charge, according to claim 1, characterized by the fact that the charging pump is situated on the level of the combustion cylinders and the high pressure part of this pump is directed towards the internal combustion engine.

6. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that the combustion cylinders are separated in respect of their inlet and exhaust slots into two parts situated on either side of the middle plane of the engine through the crank shaft and that the conduction of the exhaust gases to the charging pump as well as the conduction of fresh charge from this pump is effected on the same side of the engine.

7. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that the entrance for the exhaust gases to the charging pump as well as the exit for the fresh charge from this pump are situated on the side of this pump facing the engine.

8. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 5, characterized by the fact that a separate charging pump is correlated to one or more combustion cylinders.

9. A two-stroke cycle internal combustion engine operating with pre-compressed charge, according to claim 1, characterized by the fact that for double acting internal combustion engines one and the same charging pump is used for both sides of the piston and that the exhaust gases and the fresh charge are passed to these sides through intercommunicating conduits.

10. A two-stroke cycle internal combustion engine operating with pre-compressed charge, substantially as described and illustrated in the accompanying drawings.

Dated this 16th day of December, 1933.

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FIG. 1

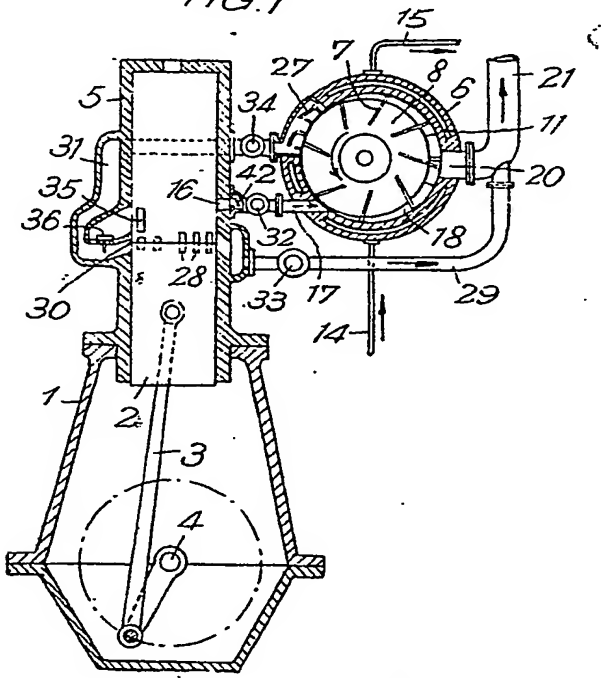


FIG. 2

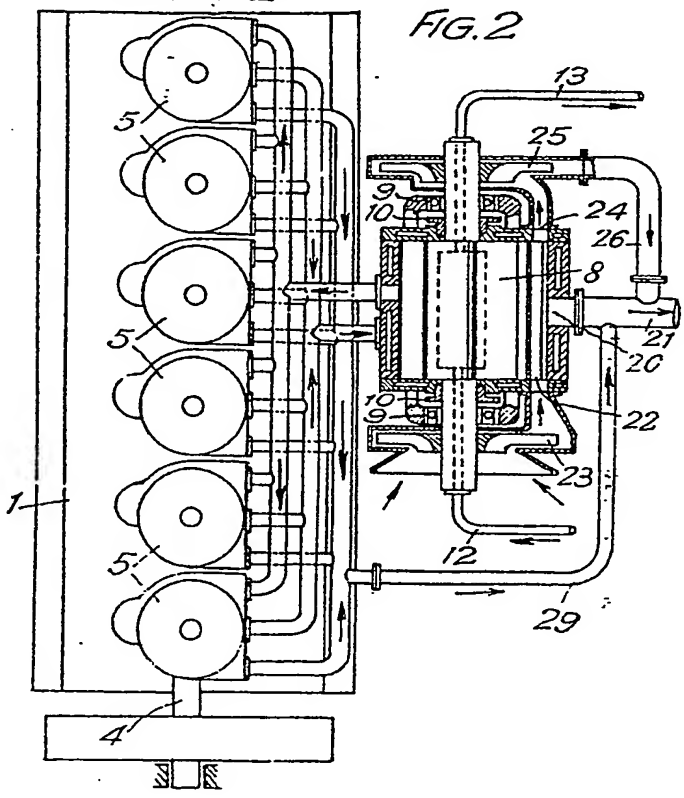


FIG. 3

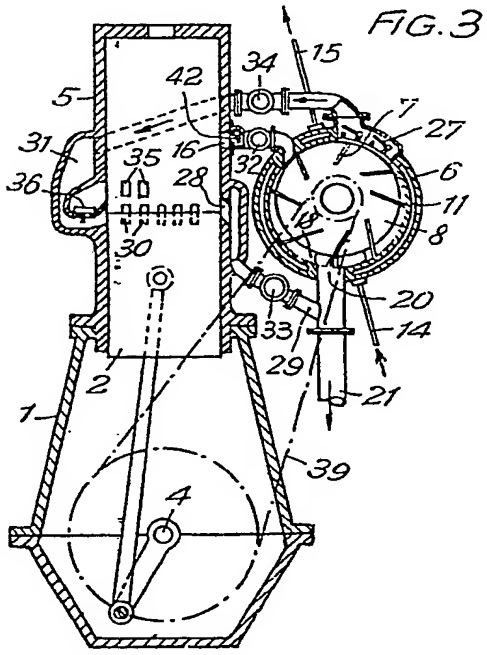
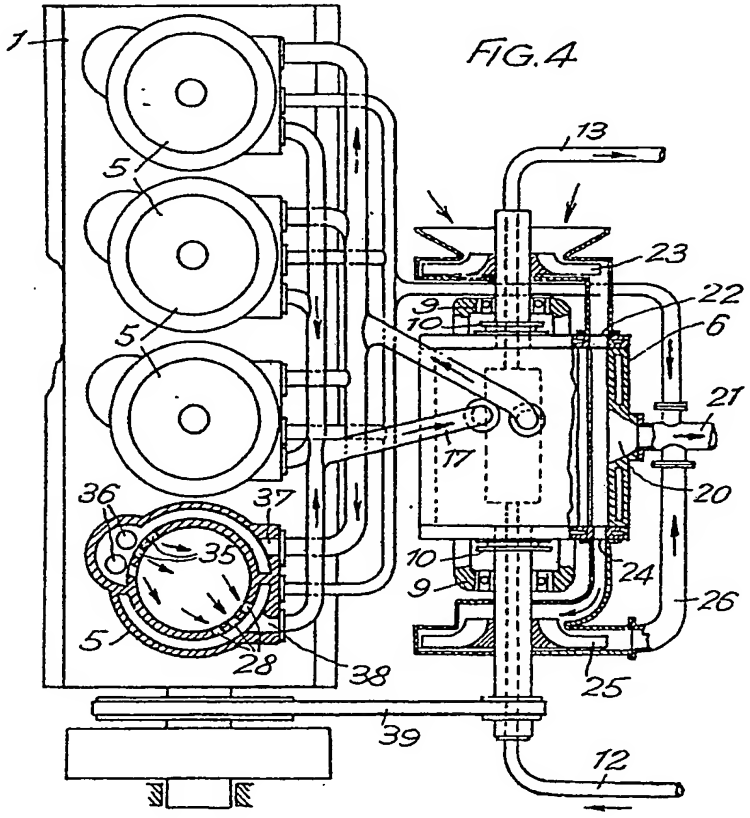


FIG. 4



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413,960 COMPLETE SPECIFICATION

FIG. 1

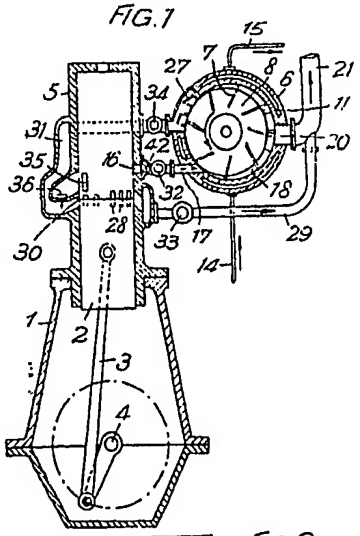

FIG. 2

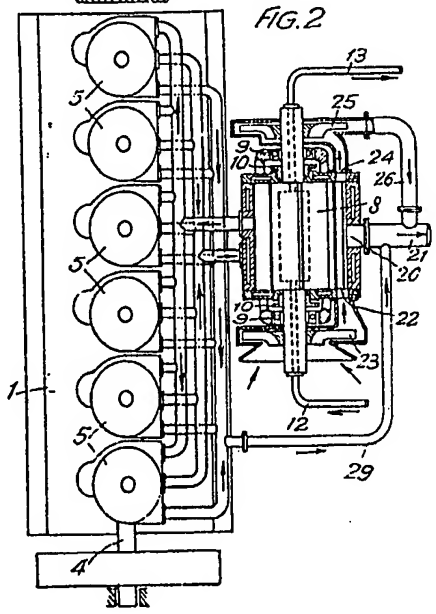

FIG. 3

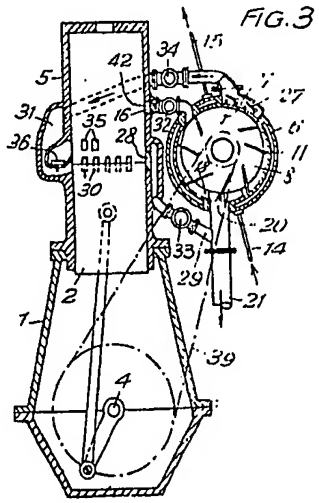

FIG. 4

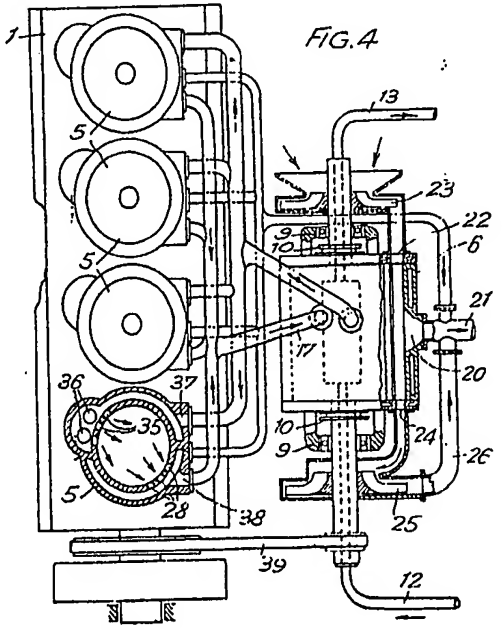

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FIG. 5

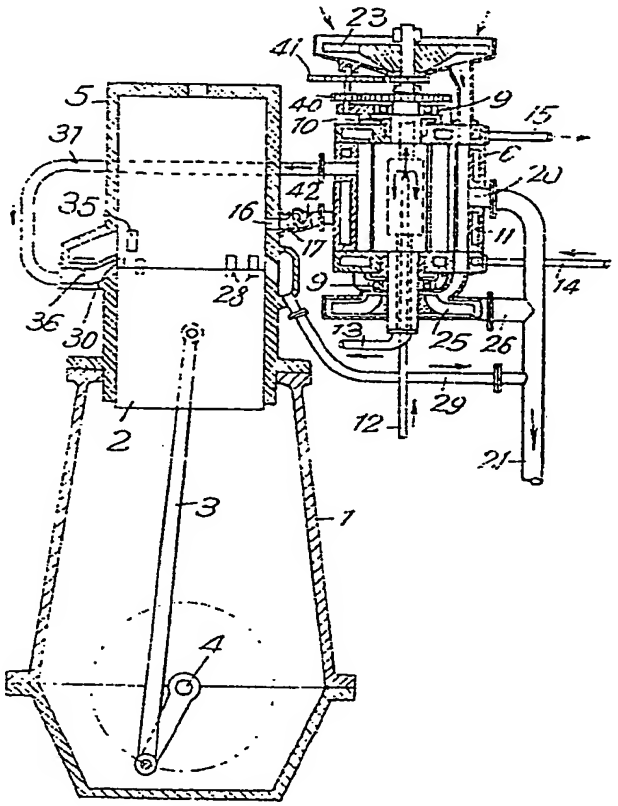

FIG. 6

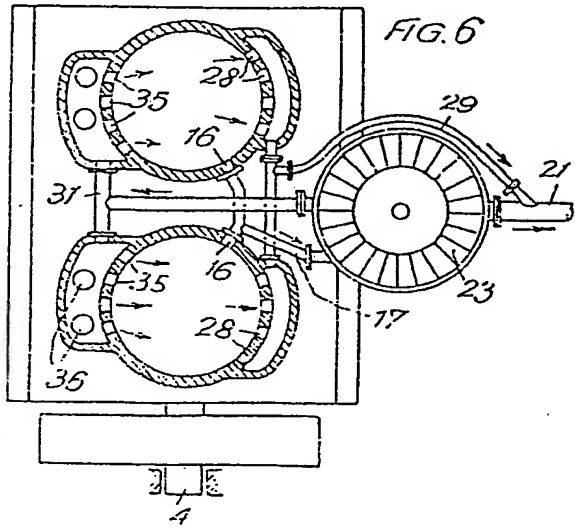

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FIG. 7

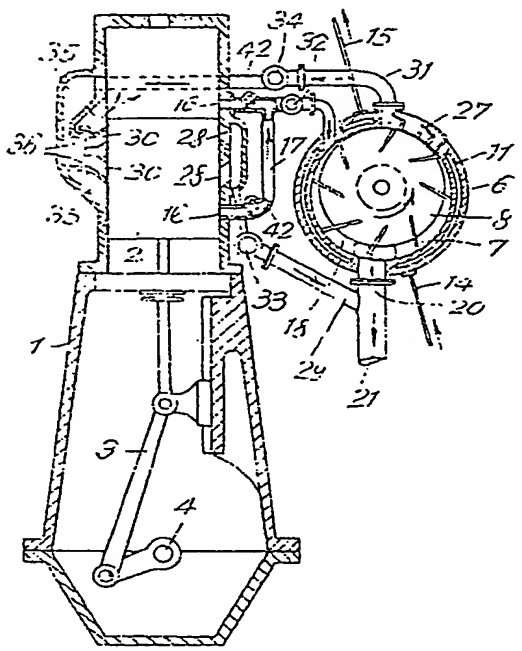
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FIG. 8

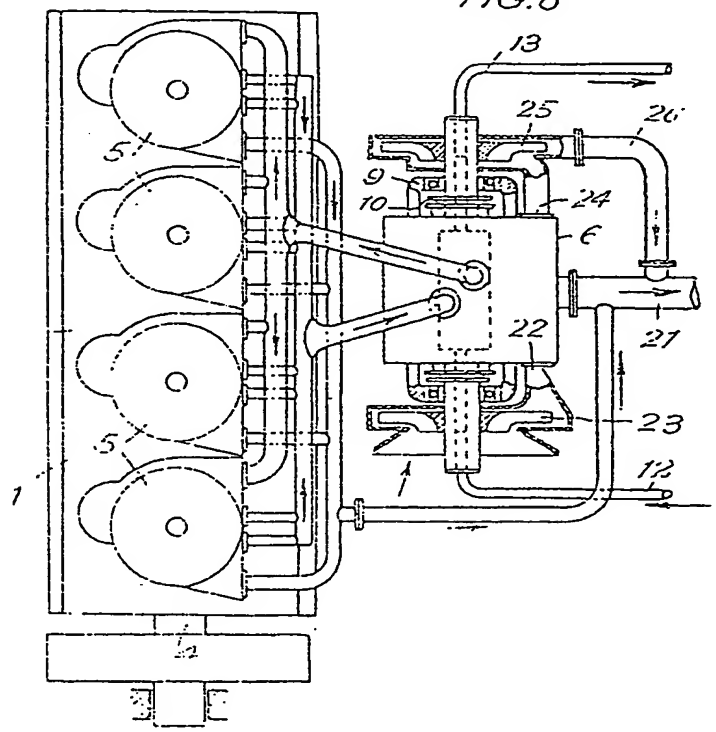
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FIG. 5

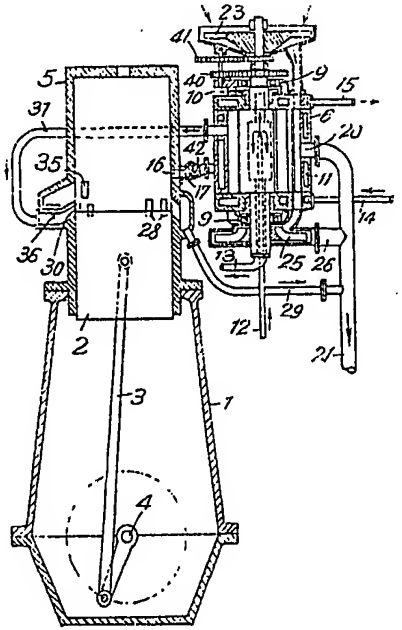


FIG. 6

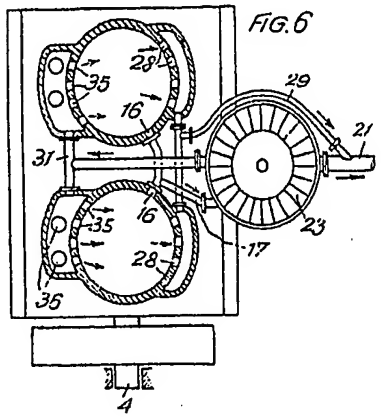


FIG. 7

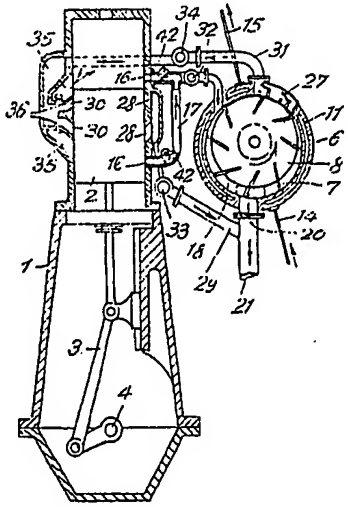
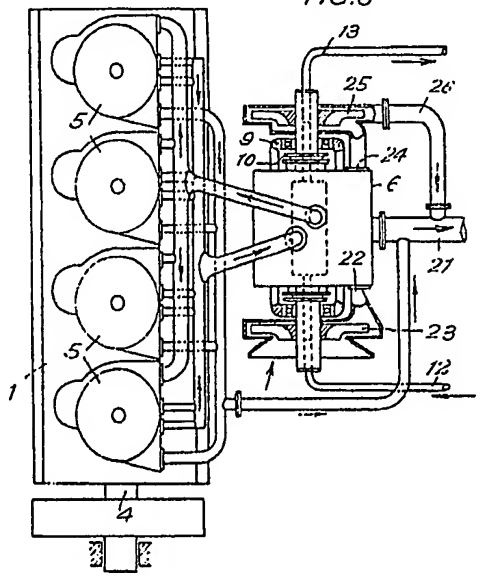


FIG. 8



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